



# Leading the Charge for Better Batteries

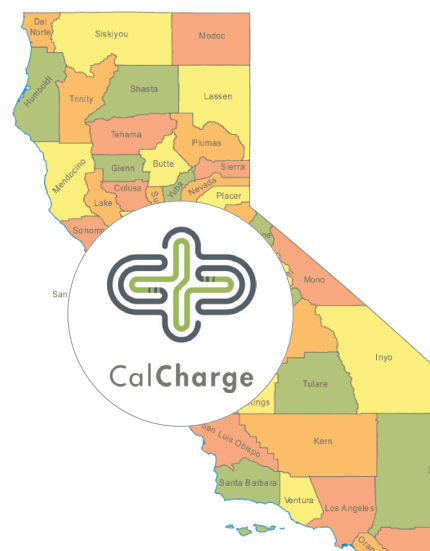
Better batteries are the linchpins of a truly sustainable energy future. Lighter, cheaper, safer, and higher energy-capacity batteries are essential for building affordable electric cars. Also needed are efficient massive battery systems to store energy from wind farms and solar energy plants, so power still flows even after the winds have died and the sun goes down.

Breakthroughs in battery technology are needed to continue the revolution that has brought the power of smartphones, laptops, and tablet computers to us all. With a renewed national commitment to energy storage research, those advances are coming, and Berkeley Lab researchers are leading the way.

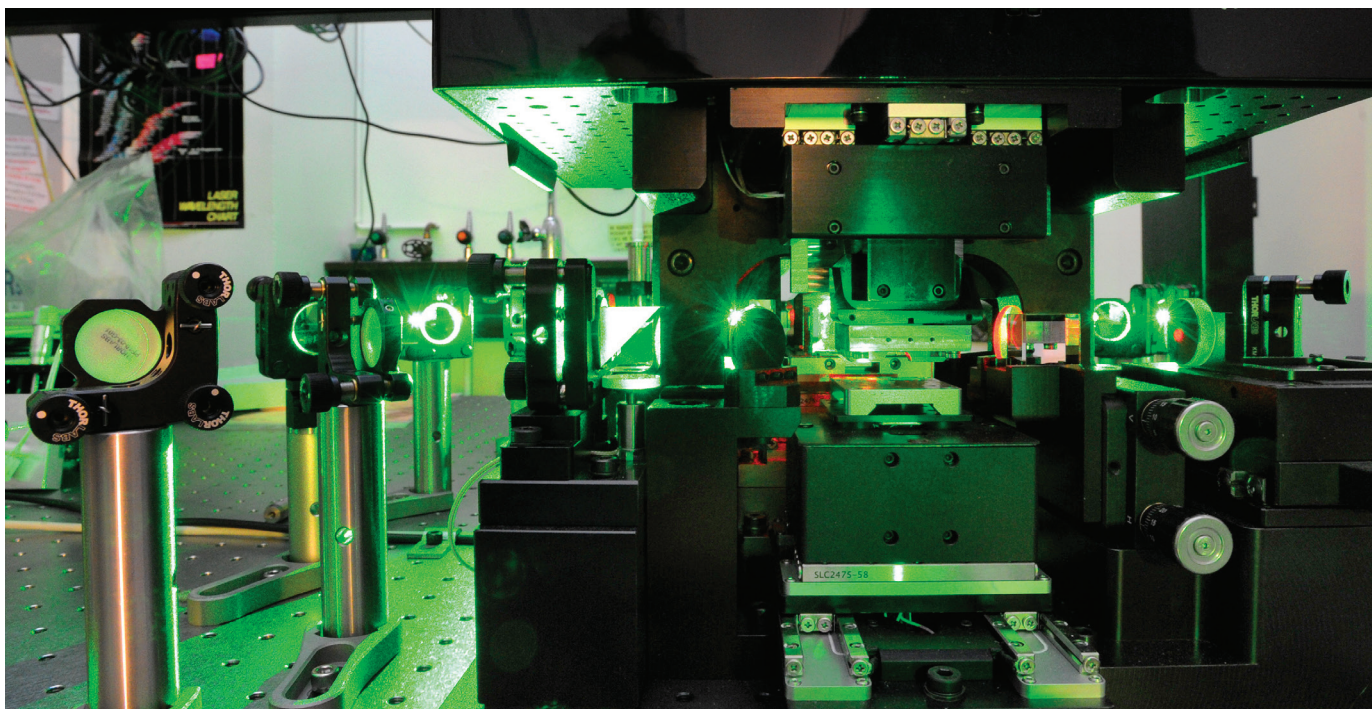
## California's Innovation Ecosystem

UC Berkeley and Berkeley Lab are long recognized for leadership in battery technology. Now, Berkeley Lab and the California Clean Energy Fund are working to partner with California companies and academic institutions to jump-start local advances in battery design, materials, and manufacturing. The new partnership, CalCharge, will nurture this blossoming battery innovation ecosystem throughout California.

With its team science approach, and drawing on its acclaimed user facilities such as the Advanced Light Source, the Molecular Foundry, and the National Energy Research Scientific Computing Center (NERSC), Berkeley Lab is also a key player in the U.S. Department of Energy's new battery and energy storage hub, the Joint Center for Energy Storage Research (JCESR).



# Big Challenges, High-Level Research



*Berkeley Lab scientists and their partners conduct research with a suite of sophisticated instruments, such as this infrared scanning microscope. It can be linked to a cascade of infrared lasers, shown here, or to infrared beamlines at the Advanced Light Source.*

Cars and trucks account for 30 percent of our nation's CO<sub>2</sub> emissions, and wider use of electric vehicles could cut fossil fuel use and greenhouse gas emissions. Electric and plug-in hybrid vehicles are essential elements for reducing carbon emissions and conserving fossil fuels. Berkeley Lab researchers aim to overcome the chemical and mechanical engineering challenges that have impeded progress toward batteries that meet the range, acceleration, costs, cycle-life, and safety requirements of 21st century vehicles. Berkeley Lab is a leader in the development of novel anode, cathode, and electrolyte materials that are the building blocks of better batteries.

Renewable energy sources such as the wind and sun cannot reach their full potential without low-cost and efficient systems of large-scale electric energy storage. Redox flow batteries, also called "regenerative fuel cells," are one promising approach to storing large amounts of energy in the electric grid. Berkeley Lab is also a world leader in the development of intelligent grid management strategies that can be integrated with improved energy storage devices for efficient distribution of renewable and conventional electric power supplies.

Throughout the 1980s, Berkeley Lab scientists pioneered the development of tools that are still critical in advanced battery research throughout the world. In the 1990s, the early groundwork in electrode research led to the founding of PolyPlus, which has since developed the promising lithium-water battery. In the first decade of the 21st century, Berkeley Lab research yielded the first block copolymer battery products, and led to the founding of Seeo, which has developed a new generation of safer lithium-ion batteries.



Battery sciences at Berkeley Lab are built upon a legacy of excellence established in the 1950s by Charles W. Tobias, widely viewed as the founding father of electrochemical engineering. A refugee from Hungary who became an inspirational UC Berkeley professor, he trained generations of PhDs from around the globe and founded Berkeley Lab's electrochemical research program, which continues to make significant advances in the development of longer-lasting, higher-capacity batteries.

For more details and the latest news, visit [www.lbl.gov](http://www.lbl.gov).

